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ARKANSAS

# WORK PLAN

- FOR
- WATERSHED PROTECTION
- FLOOD PREVENTION
- AGRICULTURAL WATER MANAGEMENT

## LEE-PHILLIPS

## WATERSHED

LEE AND PHILLIPS COUNTIES, ARKANSAS

ARKANSAS

JULY 1963

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WATERSHED WORK PLAN AGREEMENT

between the

Lee County Soil Conservation District

Local Organization

Phillips County Soil Conservation District

Local Organization

Lee-Phillips Drainage District

Local Organization

Beaver Bayou Drainage District

State of Arkansas  
(hereinafter referred to as the Sponsoring Local Organization)

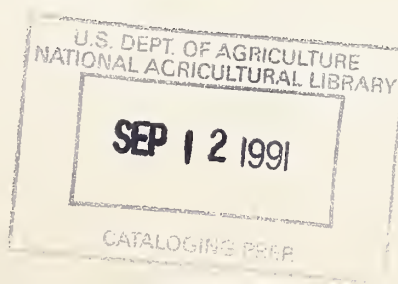
and the

Soil Conservation Service  
United States Department of Agriculture  
(hereinafter referred to as the Service)

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Lee-Phillips Watershed, State of Arkansas under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Lee-Phillips Watershed, State of Arkansas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;





Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about five years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost \$ 248,192.)
2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement.
3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization</u> (percent)	<u>Service</u> (percent)	<u>Estimated Construction Cost</u> (dollars)
Main Ditch No. 1 (Lick Creek)	12.2602	87.7398	315,787
Lateral Into Main Ditch No. 1			
Main Ditch No. 2			
Lateral Into Main Ditch No. 2			
Lateral Ditch 1-B			
Lateral Into 1-B	12.8650	87.1350	606,515
Lateral Ditch 1-A			
Lateral Into 1-A			
Lateral Ditch 1-C			
Lateral Into 1-C			
Lateral Ditch 1-D			
Lateral Into 1-D	11.5403	88.4597	163,524





The Sponsoring Local Organization will pay all of the costs allocated to purposes other than flood prevention, and irrigation, drainage, and other agricultural water management.

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

<u>Works of Improvement</u>	<u>Sponsoring Local Organization (percent)</u>	<u>Service (percent)</u>	<u>Estimated Installation Service Cost (dollars)</u>
Main Ditch No. 1 (Lick Creek)	0	100	85,254
Lateral Into Main Ditch No. 1			
Main Ditch No. 2			
Lateral Into Main Ditch No. 2			
Lateral Ditch 1-B			
Lateral Into 1-B	0	100	163,741
Lateral Ditch 1-A			
Lateral Into 1-A			
Lateral Ditch 1-C			
Lateral Into 1-C			
Lateral Ditch 1-D			
Lateral Into 1-D	0	100	44,148

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost \$ 4,930.)
6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50% of the land above each floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.
7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.
8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.
9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work.
10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.



11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid. Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.
13. No member of or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

Lee County Soil Conservation District  
Local Organization

By Thos. H. Gilbert

Title Chairman

Date December 17, 1963

The signing of this agreement was authorized by a resolution of the governing body of the Lee County Soil Conservation District

Local Organization

adopted at a meeting held on

December 5, 1963

(Secretary, Local Organization)

Date December 17, 1963



Phillips County Soil Conservation District  
Local Organization

By George Brandon

Title Chairman

Date December 17, 1963

The signing of this agreement was authorized by a resolution of the governing body of the Phillips County Soil Conservation District

Local Organization

adopted at a meeting held on December 14, 1963

Harry E. Stephens  
 (Secretary, Local Organization)

Date December 17, 1963

Lee-Phillips Drainage District

Local Organization

By Earl Mann

Title Chairman

Date December 17, 1963

The signing of this agreement was authorized by a resolution of the governing body of the Lee-Phillips Drainage District

Local Organization

adopted at a meeting held on December 14, 1963

James W. Yancy  
 (Secretary, Local Organization)

Date December 17, 1963





Beaver Bayou Drainage District

Local Organization

By George Brandon

Title Chairman

Date December 17, 1963

The signing of this agreement was authorized by a resolution of the governing body of the Beaver Bayou Drainage District

Local Organization

adopted at a meeting held on December 14, 1963

[Signature]  
(Secretary, Local Organization)

Date December 17, 1963

Local Organization

By \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

The signing of this agreement was authorized by a resolution of the governing body of the \_\_\_\_\_

Local Organization

adopted at a meeting held on \_\_\_\_\_

(Secretary, Local Organization)

Date \_\_\_\_\_

Soil Conservation Service  
United States Department of Agriculture

By \_\_\_\_\_

Administrator

Date \_\_\_\_\_



WORK PLAN  
FOR  
WATERSHED PROTECTION, FLOOD PREVENTION,  
AND AGRICULTURAL WATER MANAGEMENT

LEE-PHILLIPS WATERSHED  
Lee and Phillips Counties, Arkansas

Prepared Under the Authority of the  
Watershed Protection and Flood  
Prevention Act (Public Law  
566, 83rd Congress, 68  
Stat. 666), as Amended

Prepared By:

Lee County Soil Conservation District  
(Cosponsor)  
Phillips County Soil Conservation District  
(Cosponsor)  
Lee-Phillips Drainage District  
(Cosponsor)  
Beaver Bayou Drainage District  
(Cosponsor)

With Assistance By:

U. S. Department of Agriculture  
Soil Conservation Service  
Forest Service

July 1963





## TABLE OF CONTENTS

	<u>Page</u>
SUMMARY OF PLAN	1
General Summary	1
DESCRIPTION OF THE WATERSHED	3
Physical Data	3
Economic Data	5
Land Treatment Data	6
WATERSHED PROBLEMS	6
Floodwater Damage	6
Sediment and Swamping Damage	13
Erosion Damage	13
Problems Relating to Water Management	13
PROJECTS OF OTHER AGENCIES	14
BASIS FOR PROJECT FORMULATION	14
WORKS OF IMPROVEMENT TO BE INSTALLED	15
Land Treatment Measures	15
Structural Measures	17
EXPLANATION OF INSTALLATION COSTS	18
Schedule of Obligations	19
EFFECTS OF WORKS OF IMPROVEMENT	19
PROJECT BENEFITS	20
COMPARISON OF BENEFITS AND COSTS	21
PROJECT INSTALLATION	21
FINANCING PROJECT INSTALLATION	22
PROVISIONS FOR OPERATION AND MAINTENANCE	23
Land Treatment Measures	23
Structural Measures	23
TABLES	
Table 1 - Estimated Project Installation Cost	25
Table 1A - Status of Watershed Works of Improvement	26
Table 2 - Estimated Structure Cost Distribution	27
Table 2A - Cost Allocation and Cost Sharing Summary	28
Table 3 - Structure Data - Channels	29
Table 4 - Annual Costs	30
Table 6 - Comparison of Benefits and Costs for Structural Measures	31



TABLE OF CONTENTS - Continued

	<u>Page</u>
INVESTIGATIONS AND ANALYSES	32
Forestry Investigations	32
Engineering Investigations	32
Sedimentation Investigations	33
Geologic Investigations	34
Economic Investigations	35
Collection of Data	35
Estimation of Benefits	36
Table A - Summary of Primary Benefits	38
Table B - Summary - Cost Allocation and Cost Sharing	39
Project Map	40



## WATERSHED WORK PLAN

LEE-PHILLIPS WATERSHED  
Lee and Phillips Counties, Arkansas  
July 1963

### SUMMARY OF PLAN

#### General Summary

This work plan for watershed protection, flood prevention, and agricultural water management for Lee-Phillips watershed was prepared by the Lee County and the Phillips County Soil Conservation Districts, the Lee-Phillips Drainage District and the Beaver Bayou Drainage District as sponsoring local organizations. Technical assistance was furnished by the United States Department of Agriculture.

The project is located in south-central Lee County and north-central Phillips County, Arkansas. The 83,504-acre watershed is drained by Lick Creek and its principal tributary, Big Cypress Creek. There are 6,610 residents in the watershed of which about 3,510 are rural residents and 3,100 live in towns. There are about 785 farms in the project area.

The United States Forest Service administers 800 acres of the St. Francis National Forest within the watershed. These lands receive good protection, but the residual effects of past abuses still retard the general development of good soil conditions. About 6,700 acres of woodland are in private ownership. Uncontrolled woodland grazing and heavy over-cutting are the principal factors in retarding the development of good soil conditions on private forest holdings on the upland area.

The principal problems in the watershed are underdevelopment and inadequate channel capacities. The loessial plains soils, located on a higher elevation than the bottom land, will respond to improved drainage, which can be provided if the owners of these lands obtain access to the outlet channels in the bottom land. The landowners along the bottom land ditches are being flooded several times annually and will not provide rights-of-way for outlet channels. The loessial plains and bottom land soils are made up of an intermingling of soils which need drainage (49 percent) and soils which do not need drainage (46 percent). Hill land makes up the remainder of the watershed area. The effective use of these lands requires the establishment of an adequate drainage system. As a result of inadequate drainage, agricultural production has been costly and below the watershed potential. Floodwater damage to other agricultural and nonagricultural property has been relatively minor.

The watershed is located in an area which has been declared eligible for assistance under Section 5(b) of the Area Redevelopment Act due to the





high percentage of low-income families and the existence of substantial and persistent unemployment and underemployment. Local organizations have been formed to carry out the United States Department of Agriculture's Rural Areas Development program and Overall Economic Development plans have been prepared in each county.

The project is consistent with the President's directive and the Department of Agriculture's policy on soil and water conservation and rural area development.

The work plan proposes improvement of the watershed to be accomplished during a five-year period at a total estimated cost of \$2,070,746. Of this total, \$1,267,719 will be borne by Public Law 566 funds and \$803,027 will be borne by other sources.

Landowners and operators will install land treatment measures which have a measurable effect on the reduction of floodwater, sediment, erosion damage, and problems associated with agricultural water management. The cost of these measures is estimated at \$438,655. The cost will be shared \$24,365 by Public Law 566 funds and \$414,290 from other sources.

The Arkansas Forestry Commission, in cooperation with the U. S. Forest Service, will provide technical assistance for woodland treatment measures on private land under the Cooperative Forest Management Program. The U. S. Forest Service will establish land treatment measures on National Forest lands. Other land treatment measures will be installed and maintained by farm owners or operators under agreements with the Lee County and Phillips County Soil Conservation Districts.

Structural measures consist of 110 miles of main and lateral ditches with appurtenant grade stabilization structures. The total estimated cost of these measures is \$1,632,091 of which the Public Law 566 share is \$1,243,354 and the share from other sources is \$388,737. The annual operation and maintenance costs of structural measures is estimated at \$47,450.

The ratio of average annual primary benefits (\$537,226) to average annual cost of structural measures (\$157,159) is 3.4 to 1.

The Lee-Phillips Drainage District and the Beaver Bayou Drainage District will carry out the local responsibilities for installation, operation and maintenance of all structural measures. The districts, which have the powers of taxation and eminent domain, have sent a letter of intent to borrow to the Farmers Home Administration. Funds obtained from this loan will be used to finance the local costs. Revenue from assessments on benefited lands will be used to repay the loan and operate and maintain the structural measures.



## DESCRIPTION OF THE WATERSHED

### Physical Data

The Lee-Phillips watershed is located in south-central Lee County and north-central Phillips County, Arkansas. The 83,504-acre watershed is drained by Lick Creek and its principal tributary, Big Cypress Creek.

The northern part of the city of West Helena is within the watershed and is the major urban area within the watershed. The towns of Barton, La Grange, and Lexa are entirely within the watershed. Marianna, the county seat of Lee County, is located outside the northeast part of the watershed. Helena, the county seat of Phillips County is located outside the watershed and adjoining West Helena on the east.

Crowleys Ridge occupies a narrow strip along the eastern watershed boundary averaging about one-half mile in width from West Helena, northward to the vicinity of Marianna. The topography is steeply rolling. Extending westward from the base of Crowleys Ridge for a distance up to one mile is a compound alluvial fan. The remainder of the watershed, with the exception of the area immediately adjacent to the stream channels, is a gently undulating alluvial plain which bears old meander scars from past geologic time when the ancestral Mississippi River flowed west of Crowleys Ridge.

The soils of the watershed are of loessial origin and are predominantly deep silt loams and silty clay loams.

The present land use for the watershed is as follows:

	<u>Acres</u>	<u>Percent</u>
Cropland	63,464	76
Grassland	6,680	8
Woodland	7,515	9
Idle	2,505	3
Urban	835	1
Miscellaneous <u>1/</u>	2,505	3
Total	83,504	100

1/ Includes farmsteads, roads, railroads, etc.

The crop distribution on the 63,464 acres in cultivation is as follows: cotton, 27 percent; soybeans, 66 percent; corn, 1 percent; and wheat, 6 percent.

The woodland of Lee-Phillips watershed is made up predominantly of hardwood, with some cypress in the lowland area. The average upland site is capable of producing sawlogs of fair to good commercial value, but overcutting,





consistent "high grading", and past woodland fires have resulted in understocked stands of considerably reduced quality and vigor. Heavy woodland grazing has adversely affected stand composition and vigor. Current fire protection (the past five years) on the area is adequate for the watershed program.

The present forest stands on the upland area are made up principally of white oak, black oak, southern red oak, hard elm, hickory, dogwood, and yellow poplar. Twenty-one percent of private woodland bears merchantable stands of small sawlog size, 40 percent bears pole stands, and 39 percent is essentially unstocked or stocked with seedling and sapling stands. Fifty-seven percent of private woodland is moderately stocked, and 43 percent is poorly stocked. The average merchantable stand on private holdings on the upland area is 1,150 board feet and 217 cubic feet of cordwood (all hardwood) per acre.

The 800 acres of National Forest land on the watershed are well protected from fire and grazing damage. The average merchantable stand on this public land is some 2,300 board feet of sawtimber and 185 cubic feet of cordwood per acre.

The average annual rainfall is 48.43 inches. Although damaging rains occur more frequently in the spring, they may occur in any season. The average rainfall, by months, in inches, is:

January	5.65	July	3.67
February	4.66	August	2.84
March	4.90	September	2.89
April	4.63	October	3.18
May	4.24	November	4.05
June	3.11	December	4.16

The average frost-free period of 224 days extends from March 23 to November 2. Average temperatures range from 42.4 degrees in January to 81.0 degrees in July. Recorded extremes are 109 degrees above and 11 degrees below zero.

Water from wells is used for both domestic and irrigation purposes. Additional irrigation water is obtained from ditches.

Bobwhites, doves, and waterfowl are the major resources of interest to sportsmen. Waterfowl usage is limited principally to low-lying woodlands. A waterfowl habitat area has been planned on one farm. Due to waste grain from farm operations, wildlife food is adequate at most locations; however, cover is scarce on many farms.



Fish resources are principally in the farm ponds along the edge of Crowleys Ridge. Fishing in the main channel of the watershed is fair at times but is mostly rough type fish.

### Economic Data

The economy of the watershed depends largely on intensive agricultural enterprises. Cotton and soybeans are the principal crops. Smaller acreages are in wheat and corn.

There are 785 farm units in the watershed. Their average size is approximately 100 acres. Fifteen percent of the farm units are less than 40 acres, 46 percent are less than 100 acres, 26 percent range from 100 to 200 acres, 11 percent from 200 to 300 acres, 8 percent from 300 to 400 acres, and 9 percent above 400 acres. The small farms, although partially mechanized, are not considered economical units. Income from these units is supplemented by off-farm income, usually as day laborers for other farmers or nearby industry.

According to the census of agriculture, 28 percent of the farm operators in Lee and Phillips Counties reported they work off-farm and 6 percent reported that the value of off-farm labor exceeded the value of products sold. These figures are not significantly different from those reported in 1954.

A noticeable upward trend has occurred in the average size of farm units and the value of land and buildings in Lee and Phillips Counties. During the five-year period (1954-1959), the average-size farm unit has increased from 81 to 141 acres while the value of land and buildings per farm increased from \$7,060 to \$18,355. This is \$87 and \$141 per acre, respectively.

Woodland for lumber production in the watershed is generally in small holdings and few produce enough merchantable timber to entice lumber companies into the area; however, during years when stages on the Mississippi River have been above normal, logging operations in the watershed have been competitive. This is infrequent though and farmers have not depended on lumber production for stable income.

Industrial development in Marianna and West Helena includes the production of plastics, rubber, luggage, clothing, lumber, farm chemicals, and auto accessories.

Marianna, population 5,134, county seat of Lee County, and West Helena, population 8,385, serve as the primary commercial centers for watershed inhabitants. The populations of Marianna and West Helena were 4,530 and 6,107, respectively in 1950. These two cities also provide the needed educational and recreational facilities. Helena grew from 11,236 in 1950 to 11,500 in 1960. Smaller towns in the watershed are La Grange, Rondo, Lexa, and Barton. The populations of the smaller towns have remained relatively constant. There are 6,610 residents in the watershed, 3,510 rural, and 3,100 urban.



The watershed is adequately served by 110 miles of county and 20 miles of State and Federal roads. Rail facilities at Marianna and West Helena are provided by the Missouri Pacific Railroad.

The watershed is in an area which has been declared eligible for assistance under Section 5(b) of the Area Redevelopment Act due to the high percentage of low-income families and the existence of substantial and persistent unemployment and underemployment.

#### Land Treatment Data

The watershed is served by Soil Conservation Service work units at Marianna and Helena which are assisting the Lee County Soil Conservation District and the Phillips County Soil Conservation District, respectively. These work units have assisted district cooperators in preparing soil and water conservation plans on 40,674 acres. They have prepared 256 basic plans.

Approximately 50 percent of the agricultural land in the watershed has been planned and about 41 percent of the planned measures have been applied.

#### WATERSHED PROBLEMS

##### Floodwater Damage

The principal problem in all of the damage area is one of inadequate channel capacities to carry excess runoff. Channel capacities are not adequate to meet watershed needs. Channel capacities have been reduced by sediment produced from sheet erosion on the terrace area and from both sheet and gully erosion on Crowleys Ridge. The problem has been aggravated by the growth of willows and other undesirable vegetation which decreases the rate of flow in the channels.

Major watershed problems are found in the 40,945 acres of bottom land and loessial plains soils. The loessial plains soils of which there are 26,350 acres, include 13,292 acres of inadequately drained soils interspersed with 13,058 acres of gently undulating well drained soils. The plains soils, being at a higher elevation than bottom land soils, could be drained except for the fact that the main drains for the area, located in the bottom land, are inadequate and flood periodically. Landowners along these main drains have refused to grant easements for additional lateral improvement which further aggravates the situation. As a result, the portion of the watershed which has effective drainage installed has been limited to the owners whose land extends from the terrace area to the creek.

A major portion of the terrace area is in cultivation. Crop production on the wet soils is often limited to late variety crops. During years of higher-than-normal rainfall, complete crop failures are common on some areas, particularly on land joining the major tributaries to Lick and Big Cypress Creeks.





Crop damage on the bottom land portion of the watershed is caused principally by runoff from the loessial hills (Crowleys Ridge) and the terrace area. The bottom land is flooded several times annually and normally so wet that seedbed preparation seldom begins before crops on higher ground have been planted. Normally, the only production obtainable on the bottom land is late variety soybeans and production is often referred to as half a crop. Farmers stated that during normal years, two or three plantings may be required before suitable stands can be obtained. The risk for growing cotton in the bottom land is too great. Some farmers whose acreage allotment cannot be grown suitably on other land are forced to grow cotton in this area. Much of the idle land in the watershed occurs in this area.

Floodwater damage to nonagricultural property has been relatively minor. Interviews in West Helena revealed that during the floods of 1960 and 1962, some shallow flooding occurred to unimproved property along lateral ditch 1-A (project map). Flooding was minor and the duration was very short at West Helena which is located at the upper end of the stream. Residents report that they have noticed some increases in the flood threat due primarily to the increase in runoff caused by urban expansion in recent years. However, urban expansion appears to have enveloped nearly all of this portion of Crowleys Ridge, and further development is not likely to increase the damage.

Physical damage to other agricultural property such as farmsteads, fences, roads, and bridges is not significant because of the low velocities of floodwater. Some unimproved roads become inundated for short periods which necessitates some rerouting and delays normal farm operations but this is rather insignificant as alternate routes are available. Federal and State roads have never been impassable because of flooding.

The following pictures show some areas of inundation during recent floods of 1960 and 1962:







Flooding along Big Cypress Creek in July 1962. Picture taken 24 hours after 3-inch rain.



Same field 24 hours later.







Flooding of cropland 24 hours after 3-inch rain in July 1962. Picture taken six miles below point where Big Cypress Creek heads.



Crop damage from flood of July 1962. Picture taken 48 hours after 3-inch rain about five miles below head of Big Cypress Creek.







Flooding of second planting of crops during flood of July 1962



Another view of flooding of second planting of crops on the same farm during the flood of July 1962.







Flooding on tributary of Big Cypress Creek. Picture taken 48 hours after rain. Field completely inundated the previous day.



Flooding along Big Cypress Creek in July 1962. Picture taken 24 hours after 3-inch rain.







Upstream



Downstream

View of channel looking up and downstream from farm bridge. Note the choke section looking downstream. Picture taken 24 hours after rain four miles above the outlet. 1960 flood.

PHOTOS COURTESY OF LESTER CRAWFORD, MARVELL, ARKANSAS.



Flooding in field adjoining Lick Creek in 1960.



Flooding in field adjoining field lateral. Bridge is located one-half mile from Lick Creek. Water is 18 inches deep on field in background.



### Sediment and Swamping Damage

Sediment damage is widespread. This damage consists of overbank sediment deposition and swamping on lands adjoining the main channels. Channel filling constitutes a large sediment damage.

### Erosion Damage

Erosion rates are high throughout the watershed. Approximately 95 percent of the annual gross erosion is from sheet erosion on cropland, pasture, and woodland. The high rate of erosion is due primarily to the very erosive loessial soils and the large area of row crop cultivation. The average annual gross erosion is 8,925 tons per square mile. This represents a soil loss of approximately 14 tons per acre per year. Erosion rates are high on Crowleys Ridge, but this area represents only 5 percent of the watershed and constitutes only a small part of the annual gross erosion.

### Problems Relating to Water Management

The Lee-Phillips watershed has a complex problem in the management of its water resources. A part of this complexity is brought about by the physical composition of the drainage areas. Hill land makes up about 5 percent of this area. The remainder of the watershed is made up of an intermingling of soils which need drainage (49 percent) and soils which do not need drainage (46 percent). Effective management and use of these lands requires the establishment of an adequate drainage system. This is true because field divisions along the boundaries of lands needing drainage and not needing drainage are not always practicable.

The need for adequate drainage has been recognized by local people for many years. The Lee-Phillips Drainage District was created July 11, 1917. Bonds were issued in the amount of \$285,000 and the proceeds of this bond issue were used for channel improvement on Lick and Big Cypress Creeks. During the next 30 years, the system was inadequately maintained. The burden of maintenance was greater than was planned when the original system was implemented. The high cost of maintenance was due to the annual deposition of sediment into the ditch system from the erodible soil of the watershed.

In 1949, local interests asked the Soil Conservation Service for assistance in developing a drainage system for the watershed. The needed surveys were made and a report prepared and furnished to the sponsors. The plan was not installed because the district commissioners felt they could not bear the cost of the improvements. The inability of the sponsors to resolve the financing of improvements for the lower end of the project contributed to their decision. The planned works in the lower five miles of Lick Creek would have been constructed within the Beaver Bayou Drainage District.

In lieu of the complete plan for drainage improvements, major maintenance was performed on the main channels of Lick and Big Cypress Creeks. This





work was accomplished in 1952. Drainage improvements since that time have been confined to individual or small groups due to the inadequacy of the Big Cypress and Lick Creeks to serve as an outlet.

Less than 10 percent of the watershed is being irrigated. Wells and reservoirs are the principal sources of water for irrigation and provide an adequate supply to meet anticipated future needs. No additional irrigation facilities are considered necessary since the major problem on irrigated land is the disposal of excess water. Land smoothing of uneven surface areas will be accomplished as a land treatment measure.

Management of fish and wildlife resources is done by farmers and operators working with the two soil conservation districts.

Nonagricultural water supply and pollution abatement are not problems in the watershed.

#### PROJECTS OF OTHER AGENCIES

The Corps of Engineers comprehensive review of the Mississippi River and tributaries includes a recommendation for improvement of about 23 miles of channel in the watershed. The improvements contained in this report involve a portion of Lick and Big Cypress Creeks. The recommended works have not been authorized.

The Arkansas Forestry Commission, in cooperation with the U. S. Forest Service, furnishes forest fire detection, prevention, and suppression over the watershed area and maintains a forest management assistance service for private landowners. They do not maintain a regular fire suppression crew because of the light fire load.

The U. S. Forest Service administers the National Forest lands.

#### BASIS FOR PROJECT FORMULATION

Watershed problems, as described heretofore, were discussed with the sponsoring local organizations, and the following objectives were agreed upon:

1. Provide needed land treatment measures which will increase the efficiency of land use and obtain maximum benefits from the proposed improvements.
2. Provide for an approximate two-year frequency level of protection against flood damages.
3. Provide the least costly system of needed structural measures which will adequately drain all land requiring drainage and recognize the sediment and erosion problems which are inherent to the watershed.
4. Provide for drainage outlets within one-half mile of each farm.
5. Provide the maximum protection of fish and wildlife resources.

Erosion on the loessial plain soils and grade stabilization in lateral channels draining into Lick and Big Cypress Creeks was recognized as a watershed problem by the sponsor. Two plans to overcome these problems





were investigated. The first plan consisted of a diversion or series of diversions along the base of the ridge with floodways to discharge the outflow of the diversion into the main channels. Small grade stabilization structures which would provide for sediment and flood storage also were studied in this plan. The installation of this plan did not appear feasible because of technical problems of designing the feature and the high cost of installation.

The second plan consisted of a system of laterals which would divide the drainage area into smaller segments. The laterals, due to the reduced carrying capacity, could be designed with grade stabilization structures and would be economical to install.

The second plan was selected by the sponsor as best suited to solve the watershed problems. The planned system of ditches will afford a level of protection acceptable to the sponsor and will provide for watershed development.

#### WORKS OF IMPROVEMENT TO BE INSTALLED

##### Land Treatment Measures

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs, such as is now being carried out by the Lee County and the Phillips County Soil Conservation Districts, is necessary for a sound flood prevention and water management program on the watershed. Basic to reaching this objective is the establishment and maintenance of all soil and water conservation measures essential to proper land use.

The extent of needed land treatment measures which have been applied to date within the watershed represents an expenditure by landowners and operators of approximately \$553,718 (table 1A).

Land treatment measures that are associated with good land management will include the use of conservation cropping systems, contour farming, cover and green manure crops, grasses and legumes in rotation, and crop residue use. These practices will promote better land utilization by increasing organic matter content, assist in destroying the hard pan evident in some of the soils, and permit more rapid infiltration of moisture.

Land treatment structural measures will include gradient terraces, diversions, and grassed waterways which will shorten the steeper slopes and prevent sheet erosion and rilling by directing the higher velocity water into stream channels. A decrease in damaging sediment can be expected as a result of these measures.

Land treatment measures associated with the agricultural water management phase of development will include the installation of mains and laterals,



field ditches, and spoil bank spreading and seeding. Land grading, land smoothing, and row arrangement will further condition the land so that excess water can be removed before extensive crop damage occurs. The practices will permit production to approach its fullest potential.

Land treatment measures on the 1,700 acres of pastureland will include pasture planting, pasture and hayland renovation, brush and weed control, pasture proper use, and rotation grazing. The measures will increase the relative productivity of land not suitable for cropland production as well as decrease the runoff from frequent damaging rains. Healing of present gullies and soil stability will be affected greatly by these practices. The establishment of farm ponds located to facilitate uniform grazing in accordance with the demands of pasture management and rotation grazing will provide the fullest utility of these grazing lands.

Land treatment measures on the miscellaneous land include the development and preservation of desirable wildlife habitat.

The combination of the land treatment measures are basic and essential to providing watershed protection, flood prevention, and agricultural water management. The essential measures will make possible the basic initial elements in the realization of the benefits claimed in project justification.

The acres to be treated and the estimated costs of the treatment to be applied by landowners and operators are shown in table 1. These measures will be installed during the five-year installation period. Installation and maintenance of needed land treatment measures will continue after project installation.

Hydrologic stand improvement measures will be installed on 1,467 acres of upland forest land on the watershed to help build conditions that will further retard surface runoff, stabilize soil, and speed recovery of deteriorated areas. Of this total, 800 acres are National Forest land. These measures include interplanting or seeding to obtain full stocking, release of more vigorous growing stock from low-value trees, and improvement cuts and thinnings. The forest land will need protection from grazing damage, fire, and overcutting for the hydrologic stand improvement to be most effective.

As part of the assistance provided to district cooperators, under the present Soil Conservation Service program, plans have been made to construct a fishing reservoir. It also will serve as a rest area for ducks. An additional area will be leveed and managed as a "greentree reservoir" for wintering waterfowl. District cooperators will be encouraged to develop similar reservoirs and plant food and cover patches for bobwhites, doves, rabbits, and waterfowl.

In addition, spoil banks, berms and ditch slopes in selected areas will be



seeded to a grass-lespedeza mixture to hasten stabilization of the soil. The land treatment measures will also provide food and cover for wildlife species.

An additional ten farm ponds are expected to be built on Crowleys Ridge. Farm reservoirs will provide the major fish resources of the watershed.

### Structural Measures

About 110 miles of main and lateral ditches, with appurtenances, will be installed. The two main ditches and four laterals total 53 miles and are shown on the project map. In addition, 57 miles of lateral ditches will be installed to provide adequate outlets to all the farms needing drainage. The exact locations of these laterals will be determined in the design stage when additional data are available.

All ditches will serve both flood prevention and drainage purposes. The drainage system capacity was figured using the runoff formula,  $Q = 45M^{5/6}$ , for the bottom land portion of the watershed and  $Q = 80M^{.753}$  for the hill land portion. In the formula, "M" represents the drainage area in square miles. An additional capacity equal to the expected two-year sediment deposition was provided in the two main ditches.

Approximately 130 grade stabilization structures will be installed as appurtenances in ditches and side drains where needed for grade stabilization and erosion control. These structures, for the most part, will be pipe drops or grass lining of the channels. Each drainage ditch and its appurtenant structures are planned to serve more than one landowner.

Ditch grade stabilization will be critical on the area between Crowleys Ridge and the bottom land adjoining Lick Creek. The following requirements will be observed in constructing laterals in this area:

1. Improvement of lateral 1-A will consist of clearing, by cutting the trees at ground level, and excavation of a few short sections where obstructions exist in the channel.
2. Side slopes for laterals will be 1:1.
3. All laterals will have berms of not less than 15 feet.
4. Grade stabilization structures will be installed at all points of concentration of flow from side water.
5. Special consideration will be given to establishing vegetation as soon as possible where high velocities are expected or where other factors contribute to unstable channels.





The estimated installation cost of the mains and laterals, with appurtenances, is \$1,632,091. More detailed information on quantities, costs, and design features is given in tables 1, 2, and 3.

#### EXPLANATION OF INSTALLATION COSTS

The total installation cost of the project is estimated to be \$2,070,746, of which \$1,267,719 will be paid by Public Law 566 funds and \$803,027 by other funds. Total installation cost includes \$438,655 for land treatment and \$1,632,091 for structural measures.

The cost of land treatment will be shared \$24,365 by Public Law 566 funds for technical assistance to accelerate the installation of land treatment measures, including \$3,265 for standard soil surveys, and \$414,290 by other funds. The \$414,290 from other funds includes \$29,100 for technical assistance from Public Law 46 funds, \$950 for technical assistance from the Arkansas Forestry Commission in cooperation with the United States Forest Service, and \$384,240 for the installation of land treatment measures from local funds. The \$384,240 includes \$7,025 which the U. S. Forest Service will use for land treatment measures on National Forest land. This money will come from regular funds and not from Public Law 566 funds.

Structural measures cost will be shared \$1,243,354 by Public Law 566 funds and \$388,737 by other funds. The Public Law 566 funds consist of \$950,211 for construction and \$293,143 for installation services. Other funds consist of \$135,615 for construction, \$248,192 for land, easements, and rights-of-way, and \$4,930 for administering contracts. Land, easements, and rights-of-way costs include \$67,775 for land, \$5,505 for legal fees, \$147,700 for bridge construction, and \$27,212 for fencing and water gates across the proposed ditches.

Public Law 566 funds will pay 100 percent of the construction and installation services costs allocated to flood prevention and 50 percent of the construction cost and 100 percent of the installation services cost allocated to agricultural water management. Other funds will pay 100 percent of the costs for administering contracts, legal fees, land, easements, and rights-of-way, bridge and obstacle removal or relocation of fencing and water gates, and 50 percent of the construction costs allocated to agricultural water management.

The engineer's estimate for construction costs was based on recent bids for similar projects. A 10 percent contingency allowance was added to the engineer's estimate to cover unexpected costs at the time of construction.

Costs were allocated to purpose on the basis of paragraph 1132.212h of the Watershed Protection Handbook. Public Law 566 funds will pay 84.47 percent of the installation costs allocated to flood prevention and 51.26 percent of the installation costs allocated to agricultural water management. Details of cost allocation are shown on table B.

The schedule of obligations for the five-year installation period, including the installation of both land treatment and structural measures, is as follows:



## Schedule of Obligations

Fiscal Year	Measures	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
First	Main Ditches	731,000	169,000	900,000
	Land Treatment	4,000	80,000	84,000
Second	Lateral Ditches	512,354	219,737	732,091
	Land Treatment	5,000	90,000	95,000
Third	Land Treatment	6,000	100,000	106,000
Fourth	Land Treatment	5,000	90,000	95,000
Fifth	Land Treatment	4,365	54,290	58,655
	Total	1,267,719	803,027	2,070,746

Adjustments in the schedule may need to be made from year to year in view of accomplishments actually made and if considered mutually desirable. The schedule reveals the amount of Public Law 566 and other funds obligated each year during the installation period.

EFFECTS OF WORKS OF IMPROVEMENT

After the installation of the combined program of land treatment and structural measures, benefits will accrue on all of the 40,945 acres requiring drainage. It is expected that crop damages will be eliminated from floods up to the two-year frequency event. Floods of greater magnitude will continue to inundate portions of the bottom land and terrace areas, but duration of inundation will be greatly reduced.

Though the primary purpose of the project is not to bring new land into production, the protection provided by the proposed system of ditches will permit landowners and operators to restore 1,655 acres of idle land to pasture, convert 2,590 acres of woodland to pasture, and shift crop distribution so that the different soils might produce to their fullest potential. Intensified crop production has been prohibitive on the soils under wet conditions. After the project is installed, both cotton and soybeans will be shifted to these formerly undrained soils.

Pasture acreage will increase in the form of cropland-pasture rotation and will occur primarily on farms where livestock enterprises are well established.

In addition to the benefits accruing as a result of the changes in land use and crop distribution, increases in yields on present acreage are expected. Crop yields will increase about 22 percent.



A total of 785 landowners and operators will benefit from the proposed works of improvement.

The works of improvement contained in this work plan are in keeping with the Overall Economic Development Program, prepared by the Rural Areas Development Committee for Lee and Phillips Counties, Arkansas. One of the goals set out in their program is to expand the agricultural economy with watershed programs for better drainage. The installation of the project will increase agricultural production in the watershed which, in turn, will increase the business and profits of processors of agricultural products and sellers of goods used in agriculture, and wages of those hired to do the additional work. The increase in per capita and farm income will carry out the objectives of the Area Redevelopment Act.

The redevelopment benefits accruing as a result of the structural measures included in the plan will stem from the employment of local labor for installing, operating, and maintaining the works of improvement. During the construction period of the project, it is expected that many jobs for unskilled labor will become available. Though most contractors furnish their own equipment operators, they depend to a large extent on local labor. These unskilled jobs will be important to the area, particularly since the higher rates of unemployment and underemployment are being reported in these counties. To what degree this increase in job opportunity will diminish the situation which initially placed these counties in a position eligible for assistance under the Area Redevelopment Act cannot be predicted but it is expected to provide relief. The redevelopment benefits accruing as a result of project installation, though relatively short-lived, will provide an immediate stimulus to the economy and that the benefits provided from performing maintenance will have a continuing steadying effect until the local economy can function normally.

The construction of additional farm ponds, a fishing-duck reservoir, and a greentree reservoir will make a substantial contribution to improving recreational opportunity in the watershed. The plantings on ditch-bank berms, and spoil areas will provide food and cover for bobwhites, doves, and rabbits which also will contribute to recreational opportunity.

Secondary benefits accruing as a result of the project will be obtained in the form of increased business activity by processors and transporters of agricultural products. The expanded agricultural development will require more purchases of items used in production and will permit an increase in expenditures for items that reflect the level of living. The value of the labor necessary to perform project construction and maintenance will also contribute to secondary activity.

#### PROJECT BENEFITS

The estimated primary benefits accruing to the proposed structural measures from increased farm income and reduced damages will amount to \$537,226





annually, at long-term price levels. These benefits take into account the lag for benefit accrual and incomplete participation. Benefits were divided between flood prevention and drainage on the basis of installation cost allocated to each purpose.

The secondary benefits from a national viewpoint were not considered pertinent to the economic evaluation. The local secondary benefits, though not used in project justification, will amount to \$61,590 annually.

Redevelopment benefits accruing to the project are expected to amount to \$19,260 annually. These benefits were not used in project justification.

In addition the monetary benefits used for project justification, substantial benefits will accrue through stimulation of the economic growth of the area. These will be noted in increased employment and, in general, a rise in the standards of living for watershed inhabitants. An increased sense of security will be realized also. These benefits were not evaluated in monetary terms nor were they used in project justification.

#### COMPARISON OF BENEFITS AND COSTS

The average annual cost of the structural measures (amortized total installation cost plus operation and maintenance) is estimated to be \$157,159. The structural measures are expected to produce average annual primary benefits of \$537,226, or \$3.42 for each dollar of cost (table 6).

#### PROJECT INSTALLATION

Federal assistance will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, 68 Stat. 666), as amended. The Soil Conservation Service will provide technical assistance in planning, design, preparation of specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificates of completion, and related tasks for the establishment of the planned work eligible under Public Law 566.

Land treatment measures for watershed protection on privately owned land will be established by the owners and operators. The soil conservation districts, with technical assistance from the Soil Conservation Service, will assist in the planning and application of needed measures. More technical assistance will be provided to enable farmers to apply the planned land treatment during the five-year installation period. A part of the technical assistance will be to provide adequate soil surveys for use in applying the needed land treatment. It is estimated that this will require new mapping on 20,000 acres and the conversion of inadequate existing surveys on 48,000 acres.

The Arkansas Forestry Commission, in cooperation with the United States Forest Service, will assign a forester to the project for 2.7 man-months. Foresters trained in watershed management will provide technical assistance





to private landowners to install the forestry measures of the work plan. The assistance of the foresters will be scheduled during the installation period to best achieve the project goals. The existing Cooperative Forest Management Program will handle forest management needs of private landowners on the lowland area during the installation period as well as maintaining the current level of service to private forest land of the upland area.

The two sponsoring drainage districts will be responsible for securing the necessary land, easements, and rights-of-way for all structural measures. They will provide necessary legal, administrative, and clerical personnel and needed facilities to carry out their responsibilities. The drainage districts will advertise, award, and administer the contracts.

The Lee-Phillips Drainage District was organized under the general drainage district act, Act 279 of the General Assembly of the State of Arkansas for 1909. The Beaver Bayou Drainage District was organized under a special act, Act 92 of the General Assembly of the State of Arkansas for 1907.

The two drainage districts do not encompass the entire area on which the works of improvement will be installed. The districts will, under existing authority governing drainage districts in Arkansas, adjust their boundaries to include this area.

The structural measures are to be installed in groups of measures and in the sequence given in table 2. Lateral ditches will not be constructed until outlets have been provided.

#### FINANCING PROJECT INSTALLATION

Federal assistance under authority of Public Law 566 is subject to appropriation of funds.

The cost of applying land treatment measures on private land will be borne by owners or operators of the land, with financial aid from the Agricultural Conservation Program or other Federal and State programs.

The amount of technical assistance to soil conservation district cooperators will be shared by the going Soil Conservation Service program and Public Law 566 funds.

The Arkansas Forestry Commission will share the cost of technical assistance for installation of forestry measures with Public Law 566 funds. If the Arkansas Forestry Commission is unable to provide cost-sharing funds during the first year of project installation, Public Law 566 funds will bear the entire cost the first year. During the remainder of the installation period, the Arkansas Forestry Commission will provide matching funds.



To provide funds for carrying out their obligation in the plan, the drainage districts will secure a Farmers Home Administration loan. An assessment will be levied on the benefited area to repay the loan. A letter of intent has been sent to the Farmers Home Administration.

The soil and water conservation loan program of the Farmers Home Administration is available to eligible farmers within the area. Educational meetings will be held to outline available services and eligibility requirements.

The U. S. Forest Service will use its regular funds to apply land treatment measures on Federal lands within the St. Francis National Forest. However, the installation of these measures is contingent upon the availability of funds for this purpose.

The incidental expense involved in the needed realignment of the boundaries of the two drainage districts is not believed to be great. The district commission plans to pay for this out of present funds. If these expenses become too great for the districts to bear from available sources, they will be included as a part of the funds requested through a Farmers Home Administration loan.

The commissioners believe that most of the easements and rights-of-way will be donated. For those rights-of-way which must be purchased, funds will be provided by the drainage districts.

#### PROVISIONS FOR OPERATION AND MAINTENANCE

##### Land Treatment Measures

On privately owned lands, the land treatment measures will be operated and maintained by the landowners and operators of the farms on which the measures are installed. The operation and maintenance agreements will be between the individual farm owners and operators and the Lee County or the Phillips County Soil Conservation Districts.

The Arkansas Forestry Commission, in cooperation with the U. S. Forest Service, will furnish technical assistance to operate and maintain forestry measures on private land.

The U. S. Forest Service will operate and maintain land treatment measures on National Forest lands within the watershed.

##### Structural Measures

Each drainage district (Lee-Phillips Drainage District and Beaver Bayou Drainage District) will operate and maintain main and lateral ditches and appurtenances within their respective boundaries at a total estimated





annual cost of \$47,450. The main and lateral ditches will be inspected at least annually and as needed to determine the need for control of vegetation, bank stabilization, removal of debris, sediment, or other obstacles which could result in an abnormal reduction of channel capacities.

Grade stabilization structures will be inspected at least annually to determine the need for maintenance.

Provision will be made for free access of representatives of the cosponsoring local organizations and the Soil Conservation Service to inspect and for the local organizations to provide maintenance for structural measures and their appurtenances at any time.

The cosponsoring organizations will maintain a record of all maintenance inspections and maintenance performed and have such information available for inspection by the Soil Conservation Service personnel.

The cosponsoring local organizations fully understand their obligations for maintenance and will execute specific maintenance agreements prior to the issuance of invitations to bid on the construction of structural measures.



TABLE 1 - ESTIMATED PROJECT INSTALLATION COST  
Lee-Phillips Watershed, Arkansas

Installation Cost Item	Unit	Federal	Land	Total	Estimated Cost (Dollars)						Total
					to be Applied		Public Law 566 Funds		Other Funds		
					Non-	Federal	Non-	Federal	Non-	Federal	
LAND TREATMENT											
Soil Conservation Service											
Cropland	Acre	-	22,500	22,500	-	-	-	-	301,897	301,897	301,897
Grassland	Acre	-	1,700	1,700	-	-	-	-	59,828	59,828	59,828
Miscellaneous Land	Acre	-	430	430	-	-	-	-	490	490	490
Technical Assistance											
Soil Survey											
Other											
SCS Subtotal					-	3,265	3,265	-	-	-	3,265
					-	19,800	19,800	-	29,100	29,100	48,900
					-	23,065	23,065	-	391,315	391,315	414,380
Forest Service											
Private Woodland	Acre	-	667	667	-	-	-	-	15,000	15,000	15,000
National Forest	Acre	800	-	800	-	-	-	7,025	-	7,025	7,025
Technical Assistance					-	1,300	1,300	-	950	950	2,250
FS Subtotal					-	1,300	1,300	7,025	15,950	22,975	24,275
					-	24,365	24,365	7,025	407,265	414,290	438,655
TOTAL LAND TREATMENT											
STRUCTURAL MEASURES											
Soil Conservation Service											
Mains, Laterals, and Appurtenances	Mile	-	110	110	-	950,211	950,211	-	135,615	135,615	1,085,826
Subtotal - Construction					-	950,211	950,211	-	135,615	135,615	1,085,826
Installation Services											
Soil Conservation Service											
Engineering Services					-	195,448	195,448	-	-	-	195,448
Other					-	97,695	97,695	-	-	-	97,695
Subtotal - Installation Services					-	293,143	293,143	-	-	-	293,143
Other Costs											
Land, Easements, and Rights-of-Way					-	-	-	-	248,192	248,192	248,192
Administration of Contracts					-	-	-	-	4,930	4,930	4,930
Subtotal - Other Costs					-	-	-	-	253,122	253,122	253,122
TOTAL STRUCTURAL MEASURES					-	1,243,354	1,243,354	-	388,737	388,737	1,632,091
TOTAL PROJECT					-	1,267,719	1,267,719	7,025	796,002	803,027	2,070,746
SUMMARY											
Subtotal - SCS					-	1,266,419	1,266,419	-	780,052	780,052	2,046,471
Subtotal - FS					-	1,300	1,300	7,025	15,950	22,975	24,275
TOTAL PROJECT					-	1,267,719	1,267,719	7,025	796,002	803,027	2,070,746

1/ Price Base: 1962.

July 1963



TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT  
(at time of work plan preparation)

Lee-Phillips Watershed, Arkansas

Measures	: Unit :	: Applied to Date :	: Total Cost (Dollars) <u>1/</u>
<u>LAND TREATMENT</u>			
Brush and Weed Control	Acre	494	667
Conservation Cropping System	Acre	30,151	4,523
Contour Farming	Acre	250	62
Cover and Green Manure Crop	Acre	6,950	104,250
Crop Residue Use	Acre	30,151	45,226
Farm Pond	No.	38	9,120
Land Smoothing	Acre	281	3,372
Drainage Main or Lateral	Foot	457,048	91,410
Pasture Planting	Acre	5,945	267,525
Pasture Proper Use	Acre	5,398	540
Row Arrangement	Acre	91	9
Spoil Bank Spreading	Foot	289,244	20,247
Rotation Grazing	Acre	4,738	709
Drainage Field Ditch	Foot	90,151	2,705
Terrace, Gradient	Foot	64,832	2,593
Wildlife Habitat Preservation	Acre	100	10
Wildlife Habitat Development	Acre	50	750
TOTAL	xxx	xxx	553,718

1/ Price Base: 1962

July 1963





TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION  
Lee-Phillips Watershed, Arkansas  
(Dollars) 1/

Structure Name or Number	:Installation Cost-Public Law 566 Funds: Installation Cost - Other Funds :									
	: Installation :	: Total :	: Other :	: Adm. of :	: Ease- :	: Total :	: Total :	: Total :	: Total :	: Total :
	: Services :	: Public :		: Con- :	: ments :		: tion :	: Other :	: Cost :	: Cost :
	: Engineer- :	: Law :	: 566 :	: tion :	: & R/W :					
	: ing :									
Main Ditch No. 1 (Lick Creek)	277,071	56,842	28,412	362,325	38,716	1,435	28,449	68,600	430,925	
Lateral Into Main Ditch No. 1 2/	91,503	18,902	9,448	119,831	13,509	475	33,275	47,281	167,112	
Main Ditch No. 2	284,764	58,825	29,404	372,978	42,044	1,485	56,729	100,273	473,251	
Lateral Into Main Ditch No. 2 2/	95,915	19,814	9,903	125,637	14,161	500	35,915	50,571	176,208	
Lateral Ditch 1-B	39,193	8,096	4,047	51,357	5,787	205	17,050	23,021	74,378	
Lateral Into 1-B 2/	17,112	3,535	1,767	22,425	2,527	90	9,710	12,316	34,741	
Subtotal	528,487	109,172	54,569	692,228	78,028	2,755	152,679	233,462	925,690	
Lateral Ditch 1-A	9,925	2,020	1,010	12,953	1,295	50	2,825	4,172	17,125	
Lateral Into 1-A 2/	68,582	13,955	6,975	89,510	8,947	350	24,300	33,599	123,109	
Lateral Ditch 1-C	6,504	1,323	662	8,480	848	35	6,274	7,166	15,646	
Lateral Into 1-C 2/	22,155	4,508	2,254	28,923	2,891	115	20,627	23,627	52,550	
Lateral Ditch 1-D	28,582	5,816	2,907	37,306	3,728	145	8,692	12,564	49,870	
Lateral Into 1-D 2/	8,905	1,812	906	11,629	1,162	45	4,346	5,547	17,176	
Subtotal	144,653	29,434	14,714	188,801	18,871	740	67,064	86,675	275,476	
GRAND TOTAL	950,211	195,448	97,695	1,243,354	135,615	4,930	248,192	388,737	1,632,091	

1/ Price Base: 1962.

2/ Cost of unnumbered laterals was estimated from a typical structure and is not shown on the project map.

July 1963



TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Lee-Phillips Watershed, Arkansas

(Dollars) 1/

Item	Purpose		Total
	Flood	Drainage	
	Prevention		

COST ALLOCATION

## Multiple Purpose

Main Ditch No. 1	325,261	105,664	430,925
Lateral Into Main Ditch No. 1, Main Ditch No. 2, Lateral Into Ditch No. 2, Lateral Ditch 1-B, Lateral Into 1-B	687,510	238,180	925,690
Lateral Ditch 1-A, Lateral Into 1-A, Lateral Ditch 1-C, Lateral Into 1-C, Lateral Ditch 1-D, Lateral Into 1-D	211,897	63,579	275,476
Total	1,224,668	407,423	1,632,091

COST SHARING

Public Law 566	1,034,516	208,838	1,243,354
Other	190,152	198,585	388,737
Total	1,224,668	407,423	1,632,091

1/ Price Base: 1962.

July 1963





TABLE 3 - STRUCTURE DATA

CHANNELS  
Lee-Phillips Watershed, Arkansas

Channel Designation	Station Numbering : for Reach	Station : Station : (100 ft.) (100 ft.)	Area : (acres)	Watershed : Watershed : Area : Area : (acres)	Equiva- : lent : (acres)	Required : Required : Drainage : Drainage : Capacity : Capacity : (c.f.s.) (c.f.s.)	Planned : Channel : (feet)	Average : Side : (H/V)	Average : Depth : (feet)	Average : Grade : (ft./ft.)	Average : Velocity : in : (f.p.s.)	Volume : of : Excavation : (1000 cu. yds.)	
Main Ditch No. 1 (Lick Creek)	1,125	1,003	4,705	5,165	Coastal	256	240	10	1.5:1	6.0	.00035	1.60	43.2
	1,003	766	19,075	21,073	Coastal	827	807	12	1.5:1	9.0	.00045	2.70	208.7
	766	502	71,423	74,237	Coastal	2,350	2,454	30	1.5:1	14.0	.00020	3.00	130.8
	502	327	75,559	78,373	Coastal	2,453	2,673	16	1.5:1	14.0	.00070	5.16	58.1
	327	147	81,546	84,360	Coastal	2,614	2,637	18	1.5:1	14.0	.00060	4.83	149.9
	147	0	83,504	86,318	Coastal	2,690	2,726	26	1.5:1	15.0 3/	.00030	3.70	215.2
Main Ditch No. 2 (Big Cypress Creek)	781	385	15,661	15,661	Coastal	646	661	18	1.5:1	11.0	.00010	1.60	245.1
	385	0	25,040	25,040	Coastal	954	978	28	1.5:1	13.0	.00005	1.40	717.6
Lateral 1-A 1/	280	126	9,157	10,081	Coastal	446	761	-	-	-	.0014	3.10	0
	126	0	10,485	11,409	Coastal	499	896	-	-	-	.0010	2.90	0
Lateral 1-B	223	81	6,236	6,236	Coastal	300	305	8	1.5:1	5.4	.0009	2.30	42.9
	81	0	7,288	7,288	Coastal	341	354	10	1.5:1	7.5	.0003	2.10	53.5
Lateral 1-C 1/	150	60	4,795	5,645	Coastal	310	308	14	1:1	5.0	.0027	3.70	8.0
	60	0	5,016	5,866	Coastal	310	736	-	-	-	.0015	3.60	0
Lateral 1-D 1/	228	160	1,654	1,881	Coastal	110	115	6	1:1	3.2	.0035	3.00	18.7
	160	60	4,343	4,570	Coastal	231	228	10	1:1	4.6	.0013	2.70	26.5
	60	0	5,051	5,278	Coastal	261	533	-	-	-	.0003	2.10	23.2
Laterals 4/	-	-	-	-	-	-	-	-	-	-	-	-	636.3

Total Length = 110 Miles

Total Excavation = 2,577,746 Cubic Yards

1/ Portions of existing ditches will be adequate when cleared.

2/ Range of "n" values (.030 - .045).

3/ Elevation of hydraulic gradient at outlet - 161.6 feet (MSL).

4/ Tentatively located for estimates only (approximate length - 301,000 feet).

July 1963



TABLE 4 - ANNUAL COSTS

Lee-Phillips Watershed, Arkansas

(Dollars)

Evaluation Unit	: Amortization	: Operation	:
	: of	: and	:
	: Installation	: Maintenance	:
	: Costs <u>1/</u>	: Costs <u>2/</u>	: Total
Mains, Laterals, and Appurtenances	109,709	47,450	157,159

1/ Price Base: 1962, amortized for 20 years at 3.0 percent.

2/ Long-term prices, as projected by ERS, September 1957.

July 1963



TABLE 6 - COMPARISON OF BENEFITS AND COSTS

## FOR STRUCTURAL MEASURES

Lee-Phillips Watershed, Arkansas

(Dollars)

Evaluation Unit	: <u>Average Annual Benefits</u> <u>1/</u> :					:
	: Agricultural:					:Average :
	: Water :					:Annual :
	: Flood Management :					: Cost :
	: Prevention:	Drainage	: Total	: <u>2/</u>	:	Benefit- Cost Ratio
Mains, Laterals, and Appurtenances	403,134	134,092	537,226	157,159		3.4:1

1/ Price Base: Long-term prices, as projected by ERS.2/ From table 4.

July 1963





## INVESTIGATIONS AND ANALYSES

### Forestry Investigations

A field survey determined the upland forest conditions. Systematic sampling gave forest and hydrologic conditions and needed treatments. Information from State Forestry officials, other agencies, and past surveys fixed the amount of remedial measures recommended for the installation period. These measures include only those that contribute directly to flood reduction and soil stabilization.

### Engineering Investigations

The primary aim of the engineering investigations was to provide a plan for watershed protection, flood prevention, and drainage which would meet the objectives of the sponsoring local organizations.

Erosion and grade stabilization problems were anticipated on the area which lies between Crowleys Ridge and the bottomland adjoining Lick Creek. Two plans for erosion control and grade stabilization were investigated. The original plan was to protect the area from the rapid runoff from Crowleys Ridge by constructing a diversion, or series of diversions, along the base of the ridge and by installing a small floodwater retarding and grade stabilization structure on lateral 1-C. The diversion would drain south and discharge into laterals which would carry the water to Lick Creek. A tractive force analysis of channels through the area drained by the laterals indicated that it would require extremely costly design features to provide stable channels for this plan. A plane table survey of the proposed floodwater retarding and grade stabilization structure revealed inadequate storage characteristics.

The alternate plan consists of the construction of a system of laterals to divide the drainage areas into segments. The small drainage area per lateral provides for a minimum design discharge and a more realistic basis for the design and installation of these measures. The stabilization of the lateral ditch remains critical and, for this reason, a list of requirements for construction were developed. These requirements are listed as prerequisites for installing structural measures. This plan does not eliminate entirely the problem of channel instability. The plan provides for an increase in planned channel capacities equal to the two-year accumulation of sediment in these channels and for higher than normal operation and maintenance cost. With these provisions, the structural measures are on a sound engineering basis for providing the expected benefits over the 20-year project life.

The locations of the mains were determined through the use of reports of drainage surveys of the Lee-Phillips and the Beaver Bayou Drainage Districts, published by the Soil Conservation Service in 1950. Engineering field



survey data, contour maps, soils maps, and ownership maps were used in determining the locations of the laterals. The field surveys included cross sections of existing channels at about one-mile intervals and profiles of new channels which are to be constructed. Cross sections also were surveyed at all pertinent bridges and culverts.

An estimate was made of the number of miles of additional laterals needed to provide a drainage outlet near each farm. Approximate locations of these laterals were made for estimate purposes only. Their final locations will be determined during the design stage of project installation.

The local sponsors furnished information as to ownerships in the watershed. Locations of the proposed drainage ditches were drawn on the ownership mosaic to eliminate channels benefiting only a single landowner or resulting primarily in bringing new land into production.

All ditches were designed for multiple-purpose use (flood prevention and drainage) using the formula,  $Q = CM^{5/6}$  for the bottomland and  $Q = 80M^{.753}$  for the hill land, where:

Q = required ditch capacity in cubic feet per second,

C = coefficient,

M = drainage area in square miles.

The value of "C" was determined to be 45 for the bottomland area. These are the coastal and minimum hill curves shown in figure 6-6, Chapter 6, "National Engineering Handbook", Section 16. An additional capacity equal to the estimated two-year sediment deposition was provided in the two main ditches.

#### Sedimentation Investigations

Detailed sediment source investigations were made in three representative areas of the watershed. These field investigations included the following:

1. A field check of the soil map of the areas; the slope in percent; the slope length in feet; and the present land use (cultivated, grassland, and woodland).
2. Average farming practices (such as terracing, contour cultivation, small grain, row crops, etc.).
3. Cover condition classes on grassland and pasture.
4. Past history of land use.



This information was used in computing the annual gross sheet erosion by the Musgrave equation and to obtain soil loss in tons per acre. These soil loss data were expanded to the entire watershed. Delivery rates and channel deposition were estimated using information obtained by comparing channel sections surveyed during this study and others surveyed in 1949. The amount of sediment, in cubic yards, expected to be deposited in channels during the project life was calculated for the engineer for his use. This is estimated to be 107,800 cubic yards annually.

In addition, channel stability studies were conducted within the watershed. A total of ten disturbed and four undisturbed samples were taken and sent to the Materials Testing Section, Soil Conservation Service, Fort Worth, Texas, for analyses. All samples were analyzed as to grain size, Atterberg limits, soluble salts, and percent dispersion. In addition, the undisturbed samples had dry unit-weight and specific gravity determined.

The void ratios were calculated for plastic undisturbed samples and ranged from 0.76 to 0.86. Using these data, the plasticity index, and a chart for estimating critical tractive force values for cohesive material furnished by the Engineering and Watershed Planning Unit, Soil Conservation Service, Fort Worth, Texas, it was found that the critical tractive force in pounds per square foot ranged from 0.034 to 0.256.

The tractive force formula was used,  $TF = WDS$  where:

TF = tractive force (pounds per square foot),

W = weight of water (62.4 pounds),

D = designed depth of flow,

S = slope (designed gradient).

In connection with this study, data on a ditch constructed along part of lateral 1-C was gathered. This ditch was constructed with a 4.3-foot depth of flow and a hydraulic gradient of 0.0017 feet/foot. Using this information, the tractive force was found to be 0.456 pounds per square foot. By using plasticity index and compactions of the soil taken from the bottom of the channel, the allowable tractive force was found to be 0.125 pounds per square foot. In addition, a channel section at Station 54+00 was chosen as typical. The "as-built" sections had an area of 66.34 square feet in December 1961. This section was resurveyed in April 1962, again in August 1962, and again in June 1963. The end area on the above dates was 80.84 square feet, 125.66 square feet, and 150.16 square feet, respectively.

#### Geologic Investigations

Lee-Phillips watershed lies entirely within the Western Mississippi Alluvial Plain of the Coastal Plain Physiographic Province. Crowleys Ridge





occupies a belt about one-half mile wide from West Helena, Arkansas, northward along the eastern watershed boundary. From the base of the ridge and extending westward is a compound alluvial fan. The width of this feature ranges from about one-half mile to one and one-half miles. The area south of the Lee County-Phillips County line and east of Lick Creek is a terrace area of Pleistocene Age where elevations average from 30 to 45 feet higher than the bottomland along the creek. Meander scars, although faint, are still in evidence in this area. Near the base of the ridge, these scars have been covered by the compound alluvial fan. They were probably formed, because of the apparent width of the meander belt, at a time when the Mississippi River flowed west of Crowleys Ridge.

The area west of Lick Creek averages about 20 to 30 feet lower than the above-described area. The soils are silts and clayey silt. Meander scars are still much in evidence over this area. The width of the meander belt indicates a much larger stream once flowed in the area, probably during Pleistocene time.

A preliminary geologic investigation was made along the channels to be improved. The soils were classified as CL and ML of the Unified Soil Classification System. It was recommended to the engineer that side slopes should be constructed as steep as is practical.

### Economic Investigations

#### Collection of Data

Agricultural damage estimates were based on field schedule information obtained from landowners and operators in Lee-Phillips watershed. The sampled area was considered sufficient and representative for purposes of evaluation. Information collected on the field schedules included the present land use, crop distribution and yields by soil units, changes made in crop distribution and cultural practices because of excessive runoff and inadequate drainage, probable shifts in crop distribution and land use after project installation, expected participation and time required for installation of on-farm drainage systems, and information pertaining to trends in agricultural production and mechanization. They also revealed the frequency and severity of crop damages.

Although the information collected on the field schedules set the primary premise for evaluating the effects of the proposed works of improvement, many decisions relevant to the economic evaluation were based on information obtained from previous studies conducted by the Soil Conservation Service. These include the two Reports of Drainage Survey and the Mississippi River and Tributaries Study, both of which discuss in some detail the effects, by soil units, of drainage improvement in the Mississippi River delta. A recent publication entitled "Agricultural Potential", a Departmental publication, was used also.



### Estimation of Benefits

Estimates of the project benefits on the 40,945 acres of benefited area were based on the expected increase in yields on present cropland, shifts in crop distribution, and the conversion of 2,590 acres of woodland to pasture. Under present conditions, crop yields were adjusted upward to reflect the production on the 13,058 acres already drained. Under project conditions, crop yields were adjusted downward slightly to account for the remaining damage from floods for which no protection is provided.

All of the benefits, though considered inseparable, were allocated to flood prevention and drainage on the basis of installation cost allocated to each purpose. None of the benefits was derived from increased acreage of allotment crops. Associated costs were deducted from the gross benefits to obtain the net benefits.

In analyzing the redevelopment benefits, consideration was given to the proportion of the installation costs that were being expended for labor in similar type construction. Recent construction experience in Arkansas disclosed that labor ranged from 6 to 8 percent of contract cost. However, due to the relative amounts of skilled to unskilled labor required in construction, it was felt that 5 percent of the installation costs would be more appropriate in this case. Redevelopment benefits from the operation and maintenance of structural measures were estimated to be 30 percent of the total cost during the first 20 years of project life. Appropriate discounting factors were used to bring these benefits to present worth. Although significant, these benefits were not used for project justification.

The analysis of secondary benefits was based on primary benefits stemming from the project, together with increased costs of producing the additional goods induced by the project. A factor of 10 percent was used in each case, as set forth in Watershed Memorandum SCS-57. Secondary benefits were not used for project justification.

Project benefits were discounted 30 percent to account for the expected low participation in on-farm drainage systems. The percent participation was based on the fact that 16 percent of the watershed is in ownerships of 40 acres or less and 47 percent of the units are smaller than 100 acres. Furthermore, the needed drainage improvements would require considerable acreages of these small holdings. Also given consideration was the fact that 28 percent of the farm operators reported having worked off their farms and 6 percent reported their off-farm labor exceeded the value of farm products sold. It was assumed, in view of these facts, that participation would be something less than that in watersheds with larger ownerships and full farm employment.

Benefits were further discounted to allow for a 5-year buildup to their full level. This made a total discount of 39.5 percent. Appropriate items of associated costs were likewise discounted by this amount.



Amortization factors used in project evaluation were determined on the basis of the expected performance of maintenance and the likelihood of the proposed ditches remaining adequate to meet the agricultural demands of the future. Installation costs were amortized for 20 years and the maintenance costs were converted to 1957 long-term price levels, as projected by ERS, September 1957.

Project costs were allocated to purpose in accordance with procedures set forth in paragraph h, second alternative, under paragraph 1132.212 of the Watershed Protection Handbook. Cost-sharing was done in accordance with procedures set forth in the policy of the Secretary of Agriculture.





Table A - Summary of Primary Benefits  
Lee-Phillips Watershed, Arkansas  
1962 Prices

Land Use	: Unit :	Acres	WITHOUT PROJECT			
	: of :		: Yield :	: Gross :	: Produc- :	: Net
	: Produc- :		: Per :	: Income :	: tion :	: Return
	: tion :		: Acre :	(dollars)	(dollars)	(dollars)
Cotton	Lb.Lint	17,135	502	2,769,770	1,922,821	846,949
(Cottonseed)	Ton	(17,135)	.452	364,015	-	364,015
Soybeans	Bu.	41,885	22	2,165,454	746,391	1,419,063
Wheat	Bu.	3,809	30	222,826	98,767	124,059
Corn	Bu.	635	32	23,978	17,405	6,573
Pasture	AUM	6,680	4.8	78,557	15,965	62,592
Woods		7,515	-	-	-	-
Idle		2,505	-	-	-	-
Urban		835	-	-	-	-
Miscellaneous		2,505	-	-	-	-
Total		83,504	-	5,624,600	2,801,349	2,823,251

Land Use	: Unit :	Acres	WITH PROJECT			
	: of :		: Yield :	: Gross :	: Produc- :	: Net
	: Produc- :		: Per :	: Income :	: tion :	: Return
	: tion :		: Acre :	(dollars)	(dollars)	(dollars)
Cotton	Lb.Lint	17,135	575	2,896,672	1,963,414	933,258
(Cottonseed)	Ton	(17,135)	.518	417,172	-	417,172
Soybeans	Bu.	41,885	30	2,952,892	763,145	2,189,747
Wheat	Bu.	3,809	30	222,826	98,767	124,059
Corn	Bu.	635	45	33,718	17,983	15,735
Pasture	AUM	11,150	5.0	136,588	26,648	109,940
Woods		4,700	-	-	-	-
Idle		850	-	-	-	-
Urban		835	-	-	-	-
Miscellaneous		2,505	-	-	-	-
Total		83,504	-	6,659,868	2,869,957	3,789,911

Increased Net Return With Project - 1962 Prices	966,660
Increased Net Return With Project - Long-Term Prices	941,689
Discounted Increased Net Return (Gross Benefit)	569,722
Less Associated Costs	32,496
Average Annual Benefit	537,226
Benefits Assigned to Flood Prevention	403,134
Benefits Assigned to Agricultural Water Management	134,092



Table B - Summary - Cost Allocation and Cost Sharing  
Lee-Phillips Watershed, Arkansas  
(Dollars) 1/

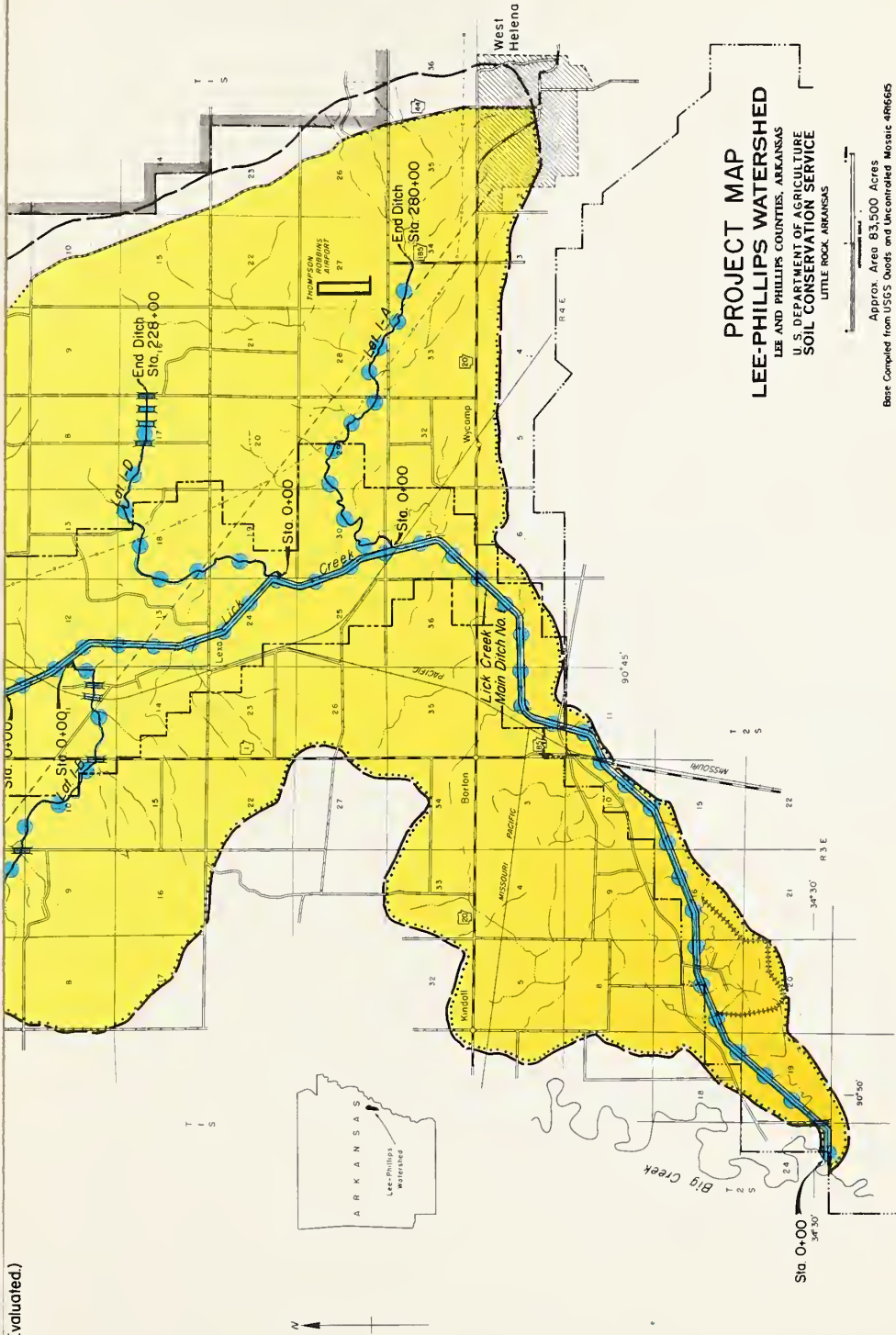
Item	Flood Prevention			Agricultural Water Management			Recapitulation		
	Public	Other	Total	Public	Other	Total	Public	Other	
Main Ditch No. 1									
Engineer's Estimate	216,687	-	216,687	35,196	35,196	70,392	251,883	35,196	
Contingencies	21,669	-	21,669	3,519	3,520	7,039	25,188	3,520	
Construction	238,356	-	238,356	38,715	38,716	77,431	277,071	38,716	
Engineering Services	42,904	-	42,904	13,938	-	13,938	56,842	-	
Other Installation Services	21,445	-	21,445	6,967	-	6,967	28,412	-	
Easements and Rights-of-Way	-	21,473	21,473	-	6,976	6,976	-	28,449	
Administration of Contracts	-	1,083	1,083	-	352	352	-	1,435	
Total Installation Cost	302,705	22,556	325,261	59,620	46,044	105,664	362,325	69,600	
Percent to Purpose			75.48			24.52			
Percent Cost Sharing	93.07	6.93	100.00	56.42	43.58	100.00	84	16	
Laterals Into Main Ditch No. 1,									
Main Ditch No. 2,									
Laterals Into Ditch No. 2									
Laterals Into 1-B,									
Laterals Into 1-B									
Engineer's Estimate	409,508	-	409,508	70,934	70,935	141,869	551,377	70,935	
Contingencies	40,951	-	40,951	7,094	7,093	14,187	48,045	7,093	
Construction	450,459	-	450,459	78,028	78,028	156,056	606,515	78,028	
Engineering Services	81,082	-	81,082	28,090	-	28,090	109,172	-	
Other Installation Services	40,528	-	40,528	14,041	-	14,041	54,569	-	
Easements and Rights-of-Way	-	113,395	113,395	-	39,284	39,284	152,679	-	
Administration of Contracts	-	2,046	2,046	-	709	709	-	2,755	
Total Installation Cost	572,069	115,441	687,510	120,159	118,021	238,180	925,690	233,462	
Percent to Purpose			74.27			25.73			
Percent Cost Sharing	83.21	16.79	100.00	50.45	49.55	100.00	75	25	
Laterals Into 1-A,									
Laterals Into 1-A,									
Laterals Into 1-C,									
Laterals Into 1-C,									
Laterals Into 1-D,									
Laterals Into 1-D									
Engineer's Estimate	114,349	-	114,349	17,155	17,155	34,310	131,504	17,155	
Contingencies	11,434	-	11,434	1,715	1,716	3,431	13,149	1,716	
Construction	125,783	-	125,783	18,870	18,871	37,741	163,524	18,871	
Engineering Services	22,641	-	22,641	6,793	-	6,793	29,434	-	
Other Installation Services	11,318	-	11,318	3,396	-	3,396	14,714	-	
Easements and Rights-of-Way	-	51,586	51,586	-	15,478	15,478	67,064	-	
Administration of Contracts	-	569	569	-	171	171	-	740	
Total Installation Cost	159,742	52,155	211,897	29,059	34,520	63,579	188,801	86,675	
Percent to Purpose			76.92			23.08			
Percent Cost Sharing	75.39	24.61	100.00	45.70	54.30	100.00	69	31	
TOTAL - Structural Measures									
Percent to Purpose	1,034,516	190,152	1,224,668	208,838	198,585	407,423	1,632,091	388,737	
Percent Cost Sharing	84.47	15.53	100.00	51.26	48.74	100.00	76.18	23.82	

1/ Price Base: 1962.

July 1963

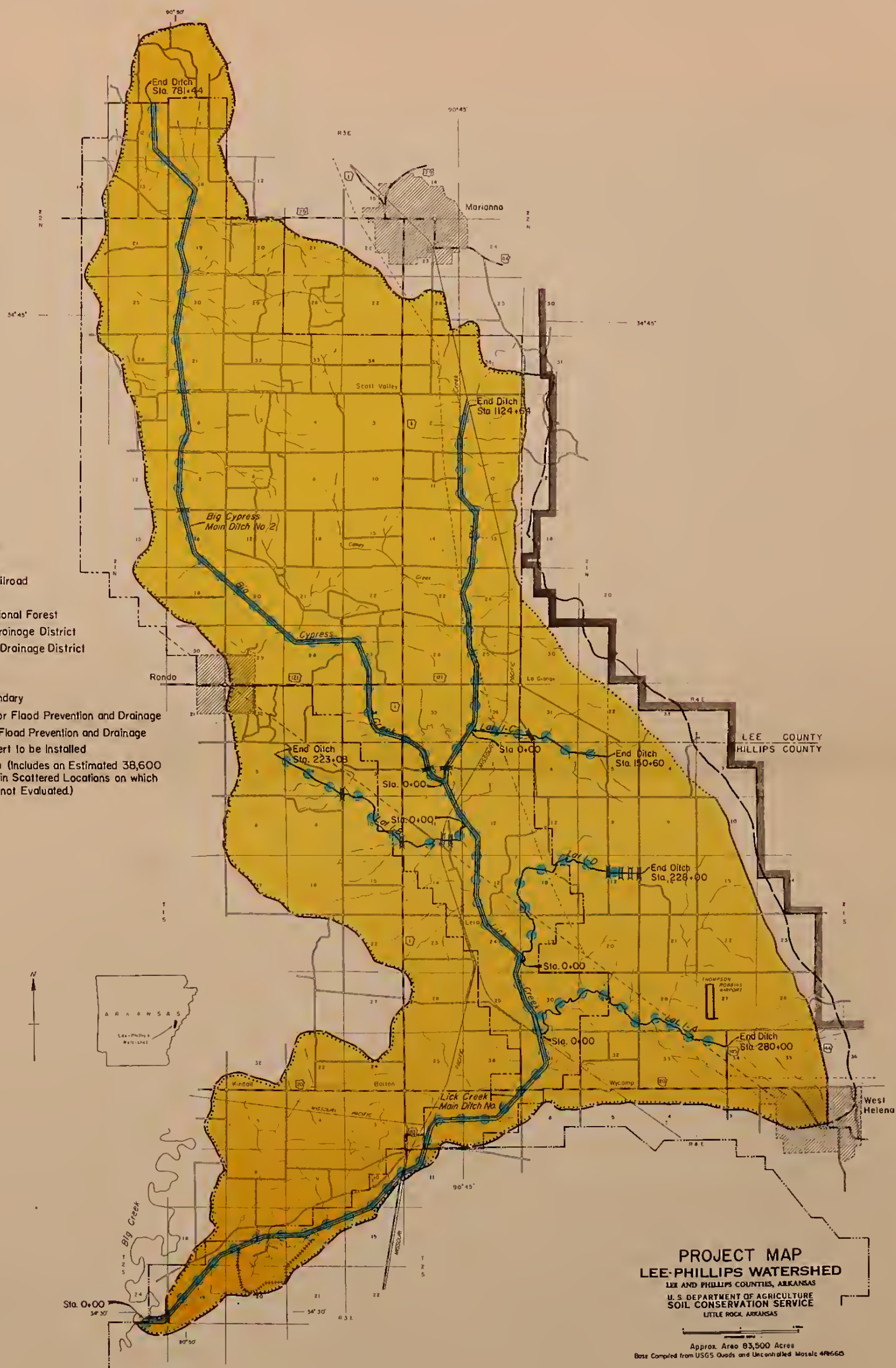


Benefits were not Evaluated.)











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